Review of
Pacific Coast Groundfish Stock Assessment Review (STAR) Panel for Data-moderate Assessments

STAR Panel, April 22 - 26, 2013
Santa Cruz, California

Prepared for:
Center for Independent Experts

Prepared by:
Vivian Haist
1262 Marina Way,
Nanoose Bay, BC
Canada V9P 9C1

1. EXECUTIVE SUMMARY

This report presents results of an independent peer review of the Pacific coast groundfish stock assessment review (STAR) for data-moderate assessments, conducted for the Center for Independent Experts. The primary activity of the review was participation in the April 22 - 26, 2013 STAR Panel in Santa Cruz, California.

The STAR panel review process was effective in furthering the development of data-moderate stock assessment methods. Stock assessment base runs were agreed for eight species (ten stocks), but there was insufficient time to review the assessments for the remaining three stocks. The assessments reviewed are technically sound, and represent the best science available for stocks assessed using data-moderate approaches.

Nearshore species, assessed using the XDB-SRA model, are brown rockfish (coast-wide stock), copper rockfish (northern and southern stocks), and china rockfish (northern and southern stocks). Although brown rockfish were assessed as a coast-wide stock, separate assessments for a northern and southern component are appropriate for apportionment to management areas. Fits to the recreational fishery abundance indices were adequate for all the assessments, with no strong patterns in residuals. Sensitivity analyses suggest that current stock status is generally better determined than absolute abundance. The XDB-SRA model is appropriate for these long-lived species, and the assessments are technically sound and provide a solid basis for management advice.

English sole, rex sole, yellowtail rockfish and sharpchin rockfish were assessed using the exSSS model, fitted to Triennial and NWFSC trawl survey abundance indices. The assessments are all coast-wide, with the exception of yellowtail rockfish which was assessed for a northern stock only. Model fits to the trawl survey indices were generally good, with the exception of the English sole, rex sole, and sharpchin rockfish fits to the NWFSC indices, a result consistent with a recent full assessment of English sole. The exSSS model is appropriate for these assessments. It follows similar structure and productivity assumptions as used in most west coast groundfish assessments based on the Stock Synthesis model. The assessments are technically sound and provide a solid basis for management.

The approach taken for the stripetail rockfish assessment differed from that taken for the other species. This species appears to be in an essentially unfished state, as indicated by their abundance in trawl surveys. While there is little information in the data for estimating absolute abundance, over a broad range of plausible values for trawl survey catchability, stock depletion estimates are relatively certain. Results of the stripetail rockfish assessment are useful for determining current stock status, but not appropriate for abundance estimates.

Objectives for this first STAR panel review of the application of data-moderate methods to groundfish stock assessments were highly ambitious. No basis for selecting a preferred model from the two used for the assessments had been developed, so the Panel spent considerable time trying to understand the differences in the assumptions of each and how these affected results. The decision to focus the review on a single model for each assessment was pragmatic, to make best use of the STAT teams time for doing additional model runs, and did not reflect a preference for one model over the other.

Considerable progress has been made in the development of the Pacific coast data-moderate stock assessment models, and the compilation and analyses of data to support those models. However, additional research and review is warranted prior to their routine application to groundfish stock assessments.

2. BACKGROUND

This document reports on an independent peer review of the Pacific coast groundfish stock assessment review (STAR) for data-moderate assessments, conducted for the Center for Independent Experts. The primary activity of the review was active participation in the April 22 - 26, 2013 STAR Panel in Santa Cruz, California.

The CIE *Statement of Work* (Appendix 2) defines the scope of this review. In addition to participation in the STAR Panel, the *Statement of Work* requests a review of draft assessment documents and other pertinent background materials prior to the review meeting and preparation of this report summarizing review findings relative to the terms of reference for the review.

3. DESCRIPTION OF REVIEW ACTIVITIES

The activities undertaken for this review include; 1) review and assimilation of background material and reports provided by the NMFS Project Contact prior to the STAR Panel meeting, 2) participation in the STAR Panel review meeting and contribution to the summary Panel report, 3) preparation of this report.

The materials provided to prepare for the STAR Panel meeting included: a draft stock assessment document for the nine species scheduled for data-moderate review; assessment documents for the species that had previous full assessments (yellowtail rockfish, vermillion rockfish, and English sole); the 2012 STAR Panel report for data-moderate methods and other documents pertinent to review of the methodologies; a document summarizing a management strategy evaluation using data-moderate models; and other background documents pertaining to the data and methods used for the data-moderate assessments (Appendix 1).

The primary focus for the STAR Panel members (Appendix 3) during the April 22 - 26, 2013, meeting included:

- Understanding the reasons for differences in modelling results from the two analytical models used in the data-moderate stock assessments and requesting additional analyses to facilitate that understanding.
- Reviewing the methods used to develop fishery dependent and fishery independent abundance indices for the stock assessments.
- Reviewing the stock assessments and working with the stock assessment teams (STAT) to determine the appropriate model and model configuration to use as the base model for each of the assessed stocks.

A STAR Panel report, summarizing meeting review activities and Panel recommendations, was prepared during and after the meeting by Panel members.

4. SUMMARY OF FINDINGS

4.1 OVERVIEW

The 2013 STAR Panel was the first to review the application of data-moderate methods to west coast groundfish stock assessments. The two analytical models used in the assessments (XDB-SRA and exSSS) had been previously reviewed by a STAR panel in 2012. That methodology review, which focussed on

comparing results of full assessments to those from the application of data-moderate models, found that the two data-moderate models were sufficiently well developed to form the basis for stock assessments. They recommended additional simulation work to further evaluate the utility of the two models.

The two data-moderate models are extensions of data-poor models that have previously been applied to west coast groundfish stock assessments. The data-poor models use only time-series of catch estimates and the data-moderate models additionally fit to relative abundance indices.

Objectives for the 2013 data-moderate STAR Panel were overly ambitious. Development of the two analytical models for routine application to groundfish stock assessments was less advanced than suggested by the 2012 STAR Panel review, and a basis for selecting between the two models not developed. Also, agreed approaches for analysing the fishery dependent and fishery independent abundance indices had not been fully specified (or tested within the assessment models) prior to the STAT teams conducting the assessments. Considerable work was required to compile and analyse the data used in the assessments, and some of this was not available to the STAT teams until shortly before the assessment document was required. Considerable effort went into preparing the main stock assessment document, however there were some changes in methodology and additional analyses that were not available until presented at the meeting. These comments are not intended to reflect poorly on the efforts of the STAT teams, who were exceedingly diligent in doing the best job possible. Rather, they are intended to indicate that although data-moderate assessments require less data than full assessments, considerable work is still required to bring that data together for use in the models. And, development of data-moderate stock assessment methodologies is still a work in progress.

The STAR panel review process was effective in further development of the data-moderate methods, and resulted in adequate review of stock assessments for eight species (ten stocks). STAR Panel members agreed all substantive issues that arose, and the STAT teams agreed with the suggested models and structure for the *base* assessments. The assessments reviewed are technically sound, and represent the best science available for stocks assessed using data-moderate approaches.

4.2 METHODS

4.2.1 Assessment Models

The two models used for the data-moderate stock assessments use Bayesian estimation, assuming uncertainty in model parameters (priors) and estimation of uncertainty in model outputs. As implemented, the two models have some parameters and assumptions in common, and differ in others. Parameters common to the two models are the level of stock depletion in year 2000 (*delta*) and natural mortality (M). Both models assume fishery selectivity is equal to the maturation ogive, and allow for process error in fitting to abundance indices (added variance to account for lack-of-fit). Stock production is modelled differently in the two approaches, and is governed by a Beverton-Holt stock-recruitment relationship in exSSS and by a production function in XDB-SRA. Priors related to stock productivity are F_{msy}/M and B_{msy}/B_0 for XDB-SRA and stock-recruitment steepness (h) for exSSS.

Parameter priors used in the data-moderate stock assessments were reviewed by the 2012 data-moderate methodology STAR Panel, and are appropriate for these assessments.

ExSSS

ExSSS is an age-structured population dynamics model that is a simplified version of the Stock Synthesis model commonly used for west coast groundfish assessments. The model developed for data-moderate stock assessments, is sex-specific and assumes a deterministic Beverton-Holt stock-recruitment relationship. Fixed inputs include sex-specific growth and length-weight parameters, maturation ogive parameters and the assumption that fishing selectivity is equivalent to the maturation ogive.

Three approaches for exSSS parameter estimation were presented for the assessments: 1) maximum likelihood estimates (MLE, or more appropriately, mode of the posterior distribution); 2) posterior distributions based on an Markov-chain Monte Carlo (MCMC) algorithm; and 3) posterior distributions based on an Adaptive Importance Sampling (AIS) algorithm. Results from MLE model fits were primarily used to compare sensitivity runs. Given the exSSS model is structured for Bayesian estimation, it would be more appropriate to compare posterior distributions for the sensitivity runs, however limitations of computing power often precludes that approach, and the MLE comparisons provide an appropriate basis for evaluating sensitivity. The stock assessment results were based on posterior distributions from the AIS algorithm.

The formulation of exSSS differed between the MCMC and AIS algorithms for estimating posterior distributions. For MCMC, a uniform prior was specified for the log of R_0. For AIS, a truncated beta prior was specified for the level of stock depletion in 2000 (*delta*). The *delta* prior is much more informative than the R_0 prior, and the MCMC algorithm generally resulted in implausibly high values of stock abundance. The rationale for using a R_0 prior for the MCMC algorithm is that including a *delta* prior would effectively place two priors on R_0, because R_0 determines *delta* given the values of other leading model parameters (see 2011 data-poor STAR Panel report). However, R_0 can be viewed as a nuisance parameter and does not require a prior distribution. In implementing AIS, draws are made from the prior distributions and R_0 estimated based on their values. I assume this requires a minimization for each parameter draw, a highly inefficient approach. This inefficiency provides a strong rationale for attempting to get the MCMC algorithm functioning - for example, the MSE simulation work was limited by the inefficiency of the exSSS AIS algorithm. When previously investigated, the MCMC *delta* prior was implemented using a pseudo survey. An actual prior on the *delta* parameter would be more appropriate. With the same prior distributions, the MCMC and AIS algorithms should converge to the same posterior distributions, a good check for model convergence.

The exSSS implementation for the data-poor stock assessments had priors for both male and female natural mortality (M). However, there was no basis for assuming M differed between the sexes (i.e. no basis for two priors), and no information in the data fitted in the assessments to estimate sex-specific M. Assuming common M for the sexes may be more appropriate, although this is unlikely to affect model results.

XDB-SRA

Extended depletion-based stock reduction analysis (XDB-SRA) is a delay-difference model that extends the DB-SRA model used for data-poor groundfish stock assessments. The productivity function combines the Pella-Tomlinson and Schaefer functions. Fishing selectivity is assumed equal to the maturation ogive, but unlike exSSS this is assumed to be knife-edged. Estimation is conducted using an AIS algorithm.

Many of the initial XDB-SRA models that fitted to the split Triennial survey data resulted in implausibly high abundance estimates. This was surprising because the exSSS model did not have similar issues. The explorations conducted during the meeting provided insight to the reason for this difference. A uniform prior is assumed for the added variance parameters (process error in fitting to abundance indices) in XDB-

SRA, whereas the analytical (MLE) estimate of added variance is used in exSSS, a highly informative prior. The XDB-SRA approach allows the model to ignore trend information in the abundance indices, attributing them to noise. The STAT team's solution to this problem was to place informative priors on the trawl survey catchability (q) parameters. This pragmatic solution is not ideal, in part because it adds one more factor that differs between exSSS and XDB-SRA and complicates model comparisons.

Further work is warranted to develop a common approach for estimating added variance in the two data-moderate stock assessment models.

Model Uncertainty

Uncertainty in parameters of management interest (stock status, OFLs) was investigated through sensitivity analyses for both the exSSS and XDB-SRA models. This included sensitivity to fitting only a single abundance index and sensitivity to alternative model priors. In general, model results were more sensitive to the exclusion of abundance indices than the form of the priors. These analyses were useful for examining the influence of each abundance index and potential conflicting signals among the indices.

A major component of uncertainty that was not investigated is the uncertainty in historical catches (landings and discard). When west coast groundfish catch histories were reconstructed, the process did not consider uncertainty in the estimates. For many of the groundfish species the uncertainty is likely large, as species composition estimates and discard rates are available for limited sampling periods and these estimates extrapolated to years without data. The sensitivity of model outputs to uncertainty in the catch histories was not investigated during the review because there was no basis for generating alternative catch streams. A process for estimating the uncertainty in catch estimates should be developed, and this uncertainty incorporated in future data-moderate stock assessments.

An additional component of uncertainty that was not investigated for the data-moderate stock assessments was the assumption that fishery selectivity was equivalent to the maturation ogive. While this is likely a reasonable assumption for many groundfish stocks, there may be cases where that assumption is inappropriate. For example, nearshore recreational fisheries may target smaller immature fish of some species. Future data-moderate groundfish stock assessments should consider whether sensitivity to this assumption is warranted.

During the review there was discussion about how uncertainty in management quantities should be expressed. The conclusion was to quantify uncertainty based on marginal posterior distributions of current stock depletion for the lowest 25%, mid 50% and upper 50% of the values from the base model run. Although this approach does not capture the full uncertainty related to model misspecification or catch histories, it is a reasonable and pragmatic approach for these data-moderate assessments at this time.

Model selection

An over-riding objective for the review was to recommend a preferred model for use in each stock assessment. For most stocks, assessments were available for both the XDB-SRA and exSSS models and the STAT teams had not selected a preferred analysis. Without an understanding of why results differed between the two models, there was no objective basis for selecting one over the other. Considerable time was spent during the review meeting to understand the differences. This was complicated because the initial applications of the two models used different treatments of the abundance index data, and significant time was needed to re-run analyses (both to generate the abundance indices and to run the Bayesian assessment models).

Investigations during the review meeting clarified some differences in the stock productivity characteristics between the two models. The exSSS stock-recruitment relationship limits stock productivity (B_{msy}/B_0 versus F_{msy}/M) to a narrow band relative to the space explored by XDB-SRA, and often resulted in much higher F_{msy}/M ratios than XDB-SRA suggesting more productive stocks. To the extent it was possible to investigate during the meeting, it appeared that the F_{msy} metric was consistent between the two models. Also, when XDB-SRA was limited to exploring the B_{msy}/B_0 versus F_{msy}/M band allowed by exSSS, results were much more similar between the two models. Further work is required to fully understand the differences between the two models.

Preliminary results from simulation testing of the XDB-SRA and exSSS models were presented at the review. While simulation work may be useful to determine the conditions under which one model outperforms the other, results from the exSSS simulations represented only a single run for each of the cases examined so it is premature to use those results as a basis for model selection. Further simulation work is warranted.

4.2.2 Abundance index standardization

Fishery independent abundance indices

Abundance indices from the AFSC Triennial shelf survey (1977 – 2004) and the annual NWFSC shelf-slope survey (2003 – 2012) were used in assessments for species which had an adequate frequency of occurrence in the surveys (English and rex sole, sharpchin, stripetail and yellowtail rockfish). Recent practise for using the Triennial survey data in west coast groundfish stock assessments is to exclude the 1977 survey and to split the remaining years into two series with the later series beginning in 1995. The rationale for this approach is that the 1977 survey did not sample depths shallower than 95 m and had a high frequency of water hauls suggesting poor gear performance, and the timing of the survey was shifted 5 weeks later beginning in 1995. A number of alternative approaches were used to develop abundance indices from the trawl survey data.

The NWFSC STAT team followed recent protocols, removing the 1977 survey data point and separating the Triennial survey data into an early and late series. They developed abundance indices using a Bayesian Delta-Generalized Linear Mixed Models (GLMM) approach. Trawl survey data were post-stratified, and deviance criterion used to select between lognormal and gamma error distributions. A novel feature of the GLMM models evaluated was the option for fitting the positive catches as a mixture distribution with an additional distribution for extreme catch events (ECEs). While modelling ECEs is potentially an improvement on traditional methods for estimating abundance indices from trawl survey data for some species, the criterion used to select among ECE and non-ECE models, visual inspection of Q-Q plots, was not appropriate. The additional parameters estimated with ECE models will always allow better fits to the data. Comparison of index trends between GLMMs with and without ECE distributions was requested, and differences found to relatively minor. The review panel appropriately determined that GLMM models with ECEs should not be used to estimate trawl survey abundance indices until a theoretically sound and robust basis for selecting between ECE and non-ECE models has been developed.

An approach investigated by the SWFSC STAT team for developing a single Triennial survey abundance index was based on fixed-effect Delta-GLM models. For each species, survey data was post-stratified and analyses limited to strata that had a reasonable probability of capturing the species. The change in timing of the Triennial survey was accounted for by partitioning the data into 3 time period strata. In practice, for most species there were problems in fitting XDB-SRA to the trawl survey data (see Section 4.2.1.2), and initial XDB-SRA models fitted to design-based swept-area abundance estimates from the Triennial and NWFSC surveys.

Comparison of results from the initial XDB-SRA and exSSS model fits was difficult because they used different abundance index data in addition to the different assumptions implicit to the two models. The review panel requested that non-ECE GLMM models, excluding 1977 from the Triennial survey series, be developed and used in the assessment models. Triennial survey abundance indices were estimated for a single time series and for time series split into early and late periods. For rex and English sole differences in trends between the single and split series were small, but for the 3 rockfish species differences were more pronounced.

Investigation of alternative approaches for estimating a single abundance time series for the Triennial survey is warranted. A single time series is much more informative for these data-moderate assessments, than indices split into two series. Approaches that treat survey covariates such as depth, time of year, and latitude as continuous variables (using polynomials, loess or other smoothing functions) would likely perform better than the factor approach (strata) used to date, as it would allow using all the data rather than eliminating strata that have had inconsistent coverage. It would also allow more realistic trends in model covariates to be forced in model fits, eliminating patterns such as the low-high-low period effects estimated for early, common, and late sampling periods (e.g. Table 12 of assessment report).

Two additional fishery-independent abundance indices were developed for potential use in the data-moderate stock assessment. The first, a power plant impingement index, was based on data collected at 5 southern California electrical generating stations. Size frequency data for this index indicates primarily juvenile fish are sampled, so appropriately the index were not used in the assessments. This index may be useful if full stock assessments are conducted in the future. The second index, a Hook and Line survey index, was based on data from the NWFSC hook and line survey in the Southern California Bight. An abundance index was developed for the southern vermillion stock complex stock assessment, which was not reviewed during the STAR panel.

Fishery dependent abundance indices

Fishery dependent abundance indices, based on recreational fishery CPUE, were developed for the nearshore rockfish stock assessments. All indices were based on commercial passenger fishing vessel data (CPFV), with the RecFIN indices developed from dockside intercept data from the MRFSS program and CPFV indices developed from on-board observer programs. Indices were developed using Delta-GLM methods after filtering data to limit observations to those with a reasonable likelihood of intercepting the species of interest (i.e. identification of suitable habitat).

Considerable effort went into aggregating the RecFIN data into trip summaries for use in the analyses. Filtering to identify trips that were likely to encounter each species was conducted using the Stephens-MacCall species co-occurrence approach. Model selection (error distributions) was based on AIC criteria, and year-interaction terms were investigated using BIC criteria. All analytical approaches used to develop the RecFIN abundance indices are theoretically sound. The RecFIN CPUE indices were truncated in 2003 because of concern that changes in fishing regulations (closed areas) would affect the indices. During the review meeting it was suggested that for some species, due to their depth distribution, this is not the case. Future data-moderate stock assessments using RecFIN CPUE indices should consider developing longer time series, as appropriate for each species.

For central California, CPFV observer data are available for two time periods that differ in the level of geographical resolution of fishing effort. For the earlier period (1988 – 1998) data is summarized by trip and site whereas for the later period (1999 – 2011) data is geo-referenced (latitude and longitude) by drift. The later data were aggregated to generate trip-based observations more consistent with the earlier data, and GIS methods used to cluster fishing sites and define suitable habitat for each species (based on

positive encounters for the drift-based data). The approach used to combine the early and late CPFV data is sound, and generated a longer time-series which is preferable to two shorter series. Sensitivity analyses to alternative buffer sizes and definitions of suitable habitat would be useful to determine if these assumptions effect the CPUE indices. Paper records of the earlier CPFV data apparently contain information at the drift level. Organizing that data so it is available electronically would allow the full time series to be analysed at the trip level, a preferable approach.

Two additional observer CPFV CPUE time series were developed, one for southern California and another that combined data for northern California and Oregon. These data were available at the drift level, and GIS methods (creating detailed hulls) and frequency of species occurrence used to determine suitable habitat. The analytical methods used were sound, though as suggested above, sensitivity analysis to the assumptions made to define suitable habitat would be useful to assess stability of the results.

4.3 STOCK ASSESSMENTS

The data-moderate stock assessments reviewed by the STAR panel fell into two categories: the nearshore rockfish, with models fitted to recreational fishery CPUE indices; and the offshore species, with models fitted to trawl survey abundance indices. There was not adequate time during the review meeting to properly evaluate results from both the XDB-SRA and exSSS models and to select a preferred model, so the Panel decided to focus the review of nearshore species assessments on the XDB-SRA model and offshore species on the exSSS model. There was no strong basis for preferring one model over the other, or for choosing a specific model for individual species, so the decision was for expedience only.

All base models were run during the review meeting, and additional work was required to complete the assessments (re-run sensitivities, longer AIS samples, etc.). As such, final results (e.g. current depletion and its uncertainty) were not available to discuss in this report.

Stock assessments for vermillion rockfish (northern stock and southern stock complex) and for southern yellowtail rockfish were not reviewed during the STAR panel meeting. There was insufficient time to review all assessments, and for two of these stocks (northern vermillion rockfish and southern yellowtail rockfish) there was no abundance information after 2003 and for the other (southern vermillion rockfish complex) the available data represented two species.

4.3.1 Brown Rockfish

Brown rockfish was assessed as a coast-wide stock, though during the review separate analyses were also conducted for northern and southern sub-stocks separated at Point Conception. This nearshore rockfish is caught in both commercial and recreational fisheries, though in the southern area recreational catches dominate. Coast-wide, catches peaked through the 1970s and 1980s at about 200 mt/year. Catches north of Cape Mendocino are minimal.

Assessments were conducted using both the exSSS and XDB-SRA models, however due to time constraints the review focussed on results from the XDB-SRA model. This model is appropriate for this relatively long-lived, low *M* species. The abundance indices fitted in the model are all recreational fishery CPUE indices: a RecFIN dockside CPFV index (1980-2003) for southern and central California; a southern California onboard CPFV index (1999-2011); and a central California CPFV observer index (1988-2011).

The XDB-SRA model fits to the coast-wide brown rockfish data were reasonable, though the model did not capture the increasing trend seen in the southern California CPFV index. Two additional analyses

that split brown rockfish into northern/central and southern regions, separated at Point Conception were requested during the review. Separate RecFIN CPFV indices were generated for central and southern California for these runs. Abundance indices were fitted better for the separate northern/central and southern runs than for the coast-wide model, and model parameters were updated to a greater degree. The AIS convergence properties were also better for the split runs, though acceptable for the coast-wide run.

For the southern sub-stock, the model estimate of stock productivity was strongly shifted to higher productivity (F_{msy}/M) from the pre-data (DB-SRA) prior. This high productivity is required by the model to fit the observed recent increases in the abundance indices, but likely does not represent the long-term productivity of this stock. For this reason, the Panel recommended the coast-wide analysis as the base assessment model. The combined abundance estimates from the northern/central and southern assessments are close to those from the coast-wide assessment, indicating the split-area assessments capture the relative size of the two sub-stocks. Results from the split-area assessments are appropriate for managers to use in apportionment.

The coast-wide XDB-SRA brown rockfish model is adequate and appropriate for management advice. Sensitivity analyses, fitting to single abundance indices, indicate considerable uncertainty with lower stock status when only the RecFIN indices are fitted. However, this index ends in 2003 so it is not surprising that the model fitted to that series only does not pick up the recent abundance increase.

4.3.2 China Rockfish

China rockfish was assessed as two sub-stocks, with the northern and central areas separated at Cape Mendocino. This nearshore rockfish is caught in both commercial and recreational fisheries, and catches have decreased in both fisheries in recent years. Coast-wide, catches were highest from the 1970s to the 1990s with maximum catches of about 50 mt/year.

Assessments were conducted using both the exSSS (coast-wide stock only) and XDB-SRA models (coast-wide, northern and central), however due to time constraints the review focussed on results from the XDB-SRA model. This model is appropriate for this long-lived, low M species. The abundance indices available for this species are from recreational fisheries. The northern sub-stock model was fitted to a RecFIN (north) dockside CPFV index (1980-2003) and an Oregon onboard CPFV index (2001-2012). The central sub-stock model was fitted to a RecFIN (central) dockside CPFV index (1980-2003) and a central California CPFV observer index (1988-2011).

Posterior distributions for the XDB-SRA model fit to the coast-wide china rockfish data suggested higher abundance and productivity than the pre-data DB-SRA model. Biomass estimates from this model were higher than the combined estimates for the northern and central sub-areas, and the coast-wide stock estimated to be less depleted than either the separate estimates for the north and the central areas. The review panel concluded that, given adequate performance of the split-stock analyses, china rockfish should be assessed as separate northern and central sub-populations.

The central china rockfish model fits the increasing trend observed in the CPFV index since the late 1990s reasonably well, with no trends in the residuals. The fit to the RecFIN data is adequate, given the noise in those data. Posterior distributions of B_{msy}/B_0, F_{msy}/M and *delta* were substantially updated from their priors, indicating the abundance indices were informative. The model sensitivity to fitting single abundance series was small in terms of current depletion, but high in terms of B_0.

The northern china rockfish model fits the declining trend in the RecFIN and CPFV CPUE indices adequately, with no trends in the residuals. Posterior distributions of model parameters were not updated

except for *delta*, and biomass estimates are only slightly updated from the pre-data (DB-SRA) estimates. The abundance indices suggest a one-way trip, so are relatively uninformative. Model results were not very sensitive to fitting only a single abundance index.

The base model assessments for the central and northern china rockfish sub-stocks are adequate for management advice. Stock status for the central sub-stock is relatively well determined from the data, while current biomass is less certain. For the northern sub-stock, both current abundance and status are relatively uncertain.

4.3.3 Copper Rockfish

Copper rockfish was assessed as two sub-stocks, with the northern and southern areas separated at Cape Conception. This nearshore rockfish is caught primarily in recreational fisheries. Catches peaked during the 1970s and 1980s and have since declined.

Assessments were conducted using both the exSSS (coast-wide stock only) and XDB-SRA models (coast-wide, northern, and southern stocks), however due to time constraints the review focussed on results from the XDB-SRA model. This model is appropriate for this long-lived, low *M* species. Abundance indices available for this species are from recreational fisheries. The northern sub-stock model was fitted to a RecFIN (north) dockside CPFV index (1980-2003), a central California onboard CPFV index (1988-2011) and an Oregon onboard CPFV index (2001-2012). The southern sub-stock model was fitted to a RecFIN (south) dockside CPFV index (1980-2003) and a southern California CPFV observer index (1999-2011).

Posterior distributions of biomass for the XDB-SRA model fit to the coast-wide copper rockfish data are much tighter than estimates from the pre-data DB-SRA model, and suggest the stock was less depleted in the 1990s. Biomass estimates from this model were similar to the combined estimates for the northern and southern sub-areas. The review panel concluded that, given adequate performance of the split-stock analyses, copper rockfish should be assessed as separate northern and southern sub-populations.

The northern copper rockfish model fits the increasing trends observed in the Oregon and central California CPFV indices reasonably well, with no trends in the residuals. The fit to the RecFIN data is adequate, given the noise in these data. Posterior distributions of F_{msy}/M and *delta* were updated somewhat from their priors, and the marginal posterior distribution of the biomass trajectory was much tighter than the pre-data (DB-SRA) estimates, indicating the abundance indices were reasonably informative. Model results were sensitive to fitting only the RecFIN CPUE index, which is not surprising given this index is relatively flat and ends in 2003.

The southern china rockfish model fits the increasing trend in the southern California CPFV CPUE index adequately, though the observed increase is greater than model predictions. Posterior distributions of model parameters ($B_{msy}/B0$, F_{msy}/M and *delta*) were updated from their prior distributions, and biomass estimates were higher than those from the pre-data (DB-SRA) model. The abundance indices are clearly informative. Model results were sensitive to fitting only a single abundance index.

The base model assessments for the northern and southern copper rockfish sub-stocks are adequate for management advice.

4.3.4 Sharpchin Rockfish

Sharpchin rockfish was assessed as a coast-wide stock. This shelf species is generally not targeted, though they have been taken in large numbers in trawl fisheries targeting Pacific ocean perch. Commercial catches (catch plus discard) north of Cape Mendocino peaked at about 900 mt/year, with little catch taken to the south. Since 2000 sharpchin rockfish catches have been negligible.

Results from the XDB-SRA and exSSS sharpchin rockfish models were reviewed and both were found acceptable for providing management advice. For pragmatic reasons, additional model runs were limited to the exSSS (AIS) model, as there was insufficient time to adequately review alternative runs from both models.

The exSSS base model run for sharpchin rockfish was fitted to the Triennial survey GLMM abundance indices (excluding 1977), split into separate early and late series, and the NWFSC abundance indices. All GLMM analyses were conducted without ECE parameters. This formulation was selected over using a single Triennial survey abundance series because that fit resulted in implausible catchability estimates (Triennial survey q slightly over 1, and NWFSC q approximately 10). With the split Triennial survey indices, catchability for the NWFSC was still fairly extreme (~4). The models are incapable of fitting the large increase in abundance estimated for the NWFSC survey relative to those for the Triennial survey, without high catchability estimates.

The base model fit the abundance index data reasonably well, with no patterns in residuals and no added variance required. The model does not follow the flat to downward trend in the NWFSC survey, predicting an increasing biomass trend. There is only slight update in the posterior distributions of steepness and *delta* relative to their priors and the pre-data (SSS) distributions, indicating catch trends rather than index trends are primarily driving results. Sensitivity to abundance indices was moderate, with final depletion estimates ranging from 0.51 to 0.92 for runs that differed in the data series fitted in the model.

The base model is adequate for informing management decisions. Scale parameters were highly uncertain, resulting in high uncertainty in OFL values.

4.3.5 Stripetail Rockfish

Stripetail rockfish is assessed as a coast-wide stock. This shelf species is found in trawl fisheries, though it is neither a target of commercial or recreational fisheries. Reported annual catches (catch plus discard) have generally been less than 50 mt. With reduced trawl fishing, since 2000 catches of stripetail rockfish have been negligible. Stripetail rockfish have not been previously assessed.

Stripetail rockfish were assessed using the XDB-SRA model as no credible results were obtained with exSSS. XDB-SRA was fitted to the Triennial trawl survey, split into an early and late series, and to the NWFSC survey indices. Informative priors on survey catchabilities were required for credible stock reconstructions. Model convergence to the posterior distribution appears good, and there was little updating of parameter values from their priors (DB-SRA) except for the *delta* parameter.

Stripetail rockfish are rarely caught and appear to be in an essentially unfished state, as indicated by their abundance in trawl surveys. There is little information in the survey data to estimate catchability, so abundance estimates are extremely uncertain. However, over a broad range of plausible values for trawl survey catchability (q range from 0.22 to 4.5), stock depletion estimates were relatively precise, ranging from 0.75 to 0.95.

The Panel concluded that status of stripetail rockfish can be estimated based on the posterior profile of *q*, but that the extreme uncertainty in abundance estimates precludes using assessment results for setting the OFL. The stripetail rockfish assessment is adequate for informing management advice regarding current status.

4.3.6 Yellowtail rockfish (North)

The yellowtail rockfish assessment was conducted for a northern stock (north of Cape Mendocino). There was not adequate time to review the assessment for the southern yellowtail rockfish stock. Yellowtail rockfish are common in both commercial and recreational fisheries, though in the northern area they are taken predominantly in commercial fisheries with peak catches (catch plus discard) in excess of 9000 mt/year. A previous full assessment of northern yellowtail rockfish was conducted in 2004 (Wallace and Lai 2005).

Results from the XDB-SRA and exSSS yellowtail (north) rockfish models were reviewed, and both were determined to be acceptable for providing management advice. For pragmatic reasons, the review focussed on the exSSS model, as there was insufficient time to adequately review both models. Initial model runs fitted to recreational and survey abundance indices, but the recreational fishery targets primarily juvenile fish so recreational indices were excluded from the base model fits.

The exSSS (AIS) base model is fitted to a single Triennial survey abundance series (1977 excluded) and the NWFSC survey abundance series. Both time series were estimated using the Bayesian GLMM analysis without ECE parameters.

The base model fit the abundance index data reasonably well, with no patterns in residuals and minimal additional variance for the NWFSC survey indices and moderate additional variance for the Triennial survey indices. There was some update of the *delta* posterior distribution relative to the pre-data (SSS) distribution, but other model parameters were not updated. Trawl survey catchability parameters were low, considered plausible for this species (median *q*s of approximately 0.2 for the Triennial survey and 0.4 for the NWFSC survey). Biomass estimates were highly uncertain. Stock biomass trends were similar between the exSSS base model run and the 2004 full stock assessment.

The yellowtail (north) base model is adequate for informing management.

4.3.7 English sole

English sole is assessed as a coast-wide resource. This shelf species, which is caught almost exclusively in trawl fisheries, has a long history of commercial exploitation with peak catches (catch plus discard), between 1920 and 1980, exceeding 4000 mt. Since 1980 catches have steadily declined. English sole are well represented in the trawl surveys, occurring in approximately 65% and 40% of Triennial and NWFSC tows, respectively. A full stock assessment of English sole was previously conducted in 2007.

Results from the exSSS (AIS) and XDB-SRA assessments were reviewed and both models were considered adequate for management. The abundance indices are reasonably informative for providing a signal for the assessments, and diagnostics indicated convergence of the posterior sampling algorithms for both models. Spawning stock biomass trends were similar for the DBA-SRA and exSSS (AIS) model runs, when DBA-SRA was fitted to the GLMM-standardized trawl survey abundance indices. Neither model was able to fit the declining trend in the NWFSC survey indices, but the 2007 full stock assessment was also not able to fit that trend either.

Both models met the criteria developed by the Panel for accepting assessments, and there was no objective basis for selecting one model over the other. The Panel concluded that exSSS was the preferred model for the English sole assessment, because it is based on the age-structured SSS model that is commonly used for US west coast groundfish assessments. Selecting this model maintains the standard productivity assumptions (i.e. Beverton-Holt stock-recruitment) commonly assumed for west coast groundfish assessments. Also, informative priors for the trawl survey catchability (q) parameter were not required for the exSSS model fits.

The selected English sole base model run is the exSSS (AIS) model fitted to the Triennial survey GLMM abundance indices (excluding 1977) split into separate early and late series, and the NWFSC abundance indices. All GLMM analyses were conducted without ECE parameters. Model results were insensitive to fitting a single or split (early/late) Triennial survey abundance series. For the base model, trawl survey q estimates were considered plausible (all slightly greater than 1), and the posterior distribution for *delta* was updated from the prior (SSS). Estimates of stock depletion were insensitive to alternative assumptions, with the exception of the model fitted only to the late Triennial survey abundance indices. Median estimates of spawning stock biomass were similar between the exSSS model and the 2007 full assessment, other than the most recent years where the additional data used in the current assessment had updated stock estimates.

The English sole exSSS (AIS) base model is adequate for informing management.

4.3.8 Rex sole

Rex sole is assessed as a coast-wide resource. Rex sole is a commonly occurring species in both trawl surveys and commercial fisheries, though it has not been commercially targeted in recent years. Catches peaked in the mid-1950s through mid-1980s, with annual catches up to 2500 mt.

Rex sole stock assessments were available for both the exSSS and XDB-SRA models. Results from XDB-SRA, when fitted to separate Triennial and NWFSC GLMM standardized survey abundance indices (similar to the data used in exSSS), were unsatisfactory. Posterior catchability (q) parameters were bimodal, resulting from alternative fits with either high additional variance for the triennial survey and a flat fit to the Triennial and NWFSC survey indices, or little additional variance and a poor fit to the NWFSC survey indices. The prior for the XDB-SRA additional variance parameter is broad and uninformative, whereas exSSS uses a highly informative prior on added variance (the MLE estimate of the additional variance). The review concluded that exSSS was the preferred model for the rex sole stock assessment.

The exSSS (AIS) base model run for rex sole fits to the Triennial survey GLMM abundance indices (excluding 1977) split into separate early and late series, and the NWFSC abundance indices. All GLMM analyses were conducted without ECE parameters. This formulation was selected over using a single Triennial survey abundance series because that fit resulted in implausible catchability estimates (qs >5). With the split Triennial survey indices, catchability estimates for the NWFSC survey was still quite high (~3.4). The models are incapable of fitting the relatively flat trend in the NWFSC survey indices, given the reductions in catch that have occurred.

For the base model run, fits to the two Triennial survey abundance indices were very good, but fits to the NWFSC survey indices were poor. The Triennial survey as a single time series is relatively informative, but when split into two series much of the value of the time series is lost. Model posterior distributions were not much updated from their prior distributions. Stock depletion estimates were relatively

insensitive to model assumptions and alternative data series fitted in the model, but scale parameters (abundance estimates) were highly sensitive to the alternative assumptions.

The base model provides an adequate basis for management, but it should be noted that the inability to fit the NWFSC survey index implies some model mis-specification. There is considerably more confidence is stock status estimates than in the biomass scale.

5. SUMMARY AND CONCLUSIONS

The STAR panel review process was effective in furthering the development of data-moderate stock assessment methods. Stock assessment base runs were agreed for eight species (ten stocks), but there was insufficient time to review the assessments for the remaining three stocks. The assessments reviewed are technically sound, and represent the best available science for stocks assessed using data-moderate approaches.

Objectives for this first STAR panel review of the application of data-moderate methods to groundfish stock assessments were highly ambitious. No basis for selecting a preferred model from the two used for the assessments (XDB-SRA and exSSS) had been developed, so the Panel spent considerable time trying to understand the differences in the assumptions of each and how these affected results. Ultimately, the Panel decided to focus on the XDB-SRA model for nearshore stocks that had fishery dependent abundance indices and to focus on the exSSS model for stocks that had fishery independent abundance indices. This decision was pragmatic, to make best use of the STAT teams time for doing additional model runs, and does not reflect a preference for one model over the other.

The nearshore species assessed using the XDB-SRA model are brown, copper, and china rockfish. Brown rockfish were assessed as a coast-wide stock, though separate assessments for a northern and southern component are appropriate for apportionment to management areas. China and copper rockfish were both assessed as two stocks, with china rockfish split at Cape Mendocino and copper rockfish split at Point Conception. Fits to the abundance indices, two or more recreational fishery CPUE series for each assessment, were all adequate with no strong patterns in residuals. Sensitivity analyses suggest that current stock status is generally better determined than absolute abundance. The XDB-SRA model is appropriate for these long-lived species, and the assessments are technically sound and provide a solid basis for management advice.

The stocks assessed using the exSSS model are English sole, rex sole, yellowtail rockfish and sharpchin rockfish. The assessments are all coast-wide, with the exception of yellowtail rockfish which was assessed for a northern stock only. All models were fitted to the Triennial and NWFSC trawl survey abundance indices. Model fits to the trawl survey indices were generally good, with the exception of the English sole, rex sole, and sharpchin rockfish fits to the NWFSC indices. For these species, the NWFSC index suggests a declining trend while the assessment indicates increasing abundance. The deterministic stock-recruitment relationship in this data-moderate model limits the ability of the model to capture this trend, given recent reductions in catch. The exSSS model is appropriate for these assessments. It follows similar structure and productivity assumptions as used in most west coast groundfish assessments based on the Stock Synthesis model. The assessments are technically sound and provide a solid basis for management.

The approach taken for the stripetail rockfish assessment differed from that taken for the other species. Stripetail rockfish are rarely caught and appear to be in an essentially unfished state, as indicated by their abundance in trawl surveys. There is little information in the data for estimating trawl survey catchability (q), so absolute abundance is highly uncertain. However, over a broad range in plausible values for q,

XDB-SRA model estimates of stock depletion ranged from 0.75 to 0.95. Results of the stripetail rockfish assessment are useful for determining current stock status, but not appropriate for abundance estimates.

Although considerable work has gone into the development and review of the Pacific coast groundfish data-moderate methodologies, there are some areas where additional research is warranted before further application of these methods. This includes both development of the analytical models and of the data used in the data-moderate assessments.

The treatment of the abundance index process error parameters differed between the two data-moderate models, with XDB-SRA assuming an uninformative uniform prior for the additional variance parameters and exSSS using the (highly informative) MLE estimates for the additional variance. In some cases this resulted in implausible results for the XDB-SRA model where reasonable results were obtained with the exSSS model. Both models should adopt the same assumptions for these parameters, and likely the approach adopted for the exSSS model is the preferred one. This warrants further investigation.

Useful diagnostics were generated for both models. In particular, presentation of the sequences from prior to pre-data (fits to SSS and DB-SRA, without abundance indices) to posterior distributions, was informative about the degree to which the abundance indices updated the assessments. Some additional diagnostics (e.g. runs tests and variance of the abundance index residuals) would be helpful to ascertain model lack-of-fit, potential model mis-specification, and to compare among models.

Additional simulation work, comparing results from the XDB-SRA and exSSS models, would be useful to understand how their productivity characteristics differ, and how each model performs when simulated conditions differ from those assumed by the models. Ultimately, simulation work may provide an objective basis for determining which model is preferred under specific conditions.

A major area of uncertainty not investigated in the data-moderate stock assessments is uncertainty in historical catch (landings and discard). For many of the west coast groundfish species this uncertainty is likely large, as species composition estimates and discard rates are available for limited sampling periods and these estimates extrapolated to years without data. A process for estimating the uncertainty in catch estimates should be developed, and this uncertainty incorporated in future data-moderate stock assessments.

A number of approaches were used to develop abundance indices from the Triennial trawl survey data, including ones that treated the data as a single time series and ones that split the data into two series. A single time series is much more informative for these data-moderate assessments, and further research on methods to develop single time series is warranted. Approaches that treat survey covariates such as depth, time of year, and latitude as continuous variables (using polynomials, loess or other smoothing functions) would likely perform better than the factor approach (strata) used to date, as it would allow using all the data rather than eliminating strata that have had inconsistent coverage.

Considerable progress has been made in the development of the Pacific coast data-moderate stock assessment models, and the compilation and analyses of data to support those models. However, additional research and review is warranted prior to their routine application to groundfish stock assessments.

Appendix 1: Bibliography of materials provided for review

1. DataModerate_Assessment_preSTAR_DRAFT.docx
1a. DataModerate_Assessment_Addendum_SharpchinRockfish_pre-STAR_DRAFT.docx
2. Wetzel_Punt_Data-Moderate_MSE_preSTAR_DRAFT.docx
3. Draft_Agenda_D-M_Review Panel_April_22-26_2013.docx
4. Stock_Assessment_Terms_of_Reference_2013-14_Final.docx

Background Documents:

Background_AbundanceIndices_Delta-GLMM_R1_proofs_for_distribution.pdf
Background_AbundanceIndices_HookandLineSurvey_Harms.et.al.FishRes_12_2010.pdf
Background_AbundanceIndices_HookandLine_Harms_RockfishSurveyTechMemo95.pdf
Background_AbundanceIndices_Impingement.4.datamod.doc
Background_AbundanceIndices_RecreationalSampling_ODFW_Tech_Memo1.pdf
Background_AbundanceIndices_Recreational_CPFVIndices_CDFG_1998_Marine_Region_Admin_Report_98-1.pdf
Background_AbundanceIndices_Recreational_CPFV_Indices_Mar-5-2013_final.pdf
Background_AbundanceIndices_Stefansson_1996.pdf
Background_AbundanceIndices_Stephens_and_MacCall_2004.pdf
Background_AbundanceIndices_TrawlFiltering.docx
Background_AbundanceIndices_bayesGLM Writeup 2.12.pdf
Background_AbundanceIndicies_Stephens_et_al_2006_CalPoly_CPFV_sampling.pdf
Background_Cope et al. 2011-PSA_GF.PDF
Background_Dick and MacCall 2010 SWFSC Tech Memo 460.pdf
Background_Dick_and_MacCall_2011.pdf
Background_Kinas_1996.pdf
Background_PreviousAssessment_English_sole_update_Final_Assement_2007.pdf
Background_PreviousAssessment_Vermillion_Assmtfinal_2005.pdf
Background_PreviousAssessment_Yellowtail_Rockfish_Final_Assessment_0506.pdf
Background_Prior_Steepness_Write-up_for_SSC_v2_June2012.docx
Background_ReviewMeetingReport_2011_Data_Poor_STAR_APRIL.pdf
Background_ReviewMeetingReport_2012_Data-Moderate_Methods_Workshop_STARReviewReport_JUNE_2012.pdf
Background_ReviewMeetingReport_2012_SSC_Statement_D-M_AssessmentMethods_SEP2012BB.pdf
Background_ReviewMeetingReport_2013_GFSubcommittee_SSC_ReviewAbundanceIndices_FullReport_030513_FINAL.docx
Background_ReviewMeetingReport_2013_SSC_Statement_AbundanceIndices_MAR2013BB.pdf
Background_West_1993.pdf
Final Summary Report from NWFSC Bottom Trawl Survey Workshop.pdf

Appendix 2: Statement of Work

Attachment A: Statement of Work for Dr. Vivian Haist

Pacific Coast Groundfish Assessment Review Panel for Data Moderate Assessments

BACKGROUND

The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

SCOPE

Project Description: The requirement in the re-authorized Magnuson-Stevens Act (2007) to set annual catch limits (ACLs) based on science recommendations implies some kind of basic assessment is required for all stocks in Fishery Management Plans (FMPs). This mandate has led to an increased focus on assessing "data-poor" and data-moderate stocks. Many of these stocks are of minor economic importance and assessing all of them using size/age structured models would be difficult given data limitations as well as requiring substantial time and effort. Simple assessment methods that use historical catches and available trend or size-composition information could potentially be applied to many data-poor stocks. These methods could be used to set ACLs, and to identify stocks which may be at risk of depletion that would be elevated to high priority for more detailed assessments.

Data-moderate assessments for groundfish species represent extensions of previously adopted data-poor methods (i.e., Depletion-Corrected Average Catch (DCAC) and Depletion-Based Stock Reduction Analysis (DB-SRA)) that use only catch data to inform harvest specifications. The defining distinction between data-moderate and data-poor assessments is that former (data-moderate) include abundance trend information.

Two data-moderate assessment methods have been endorsed for determining stock status and trends in the 2013-14 assessment cycle: 1) extended DB-SRA (XDB-SRA) and 2) extended

Simple Stock Synthesis (exSSS). In both cases, abundance trend information (e.g., survey or fishery CPUE indices) is included in the assessment, but length and age composition data are excluded by design, in order to expedite development and review of the assessments.

ExSSS is a simplified stock synthesis model that assumes that recruitment is related deterministically to the stock-recruitment relationship and allows index and catch data to be used to fit a population model. Uncertainty is quantified using Markov chain Monte Carlo (MCMC) or other resampling algorithms. The other method, XDB-SRA is implemented within a Bayesian framework, with the priors for the parameters updated based on index data. The additional parameters in XDB-SRA compared with DB-SRA include the catchability coefficient (q), and the extent of observation variance additional to that inferred from sampling error (a). The priors for these parameters are a weakly informative log-normal and a uniform distribution, respectively.

While data-moderate assessments are less complicated than full assessments, and can potentially be reviewed more expeditiously than full assessments, this full STAR panel will be held to review data-moderate assessments because this is the first time that these methods have been used for stock assessment. Previous panel reviews focused on the methodology development and evaluation of model performance.

OBJECTIVES

Requirements for the reviewers: Two reviewers, with one of the reviewers participating in all stock assessment reviews (STAR) in 2013, shall conduct an impartial and independent peer review of the stock assessments that are provided, and this review should be in accordance with this SoW and stock assessment ToRs herein. The reviewers shall have working knowledge and recent experience in fish stock assessments. In general, the reviewers shall have working knowledge and recent experience in the application of expertise in fish population dynamics, with experience in quantitative stock assessment using a range of assessment techniques ranging from simple to complex, use of sampling algorithms such as MCMC to evaluate uncertainty, and use of Generalized Linear Models to develop abundance indices.

PERIOD OF PERFORMANCE

The reviewers shall conduct the tasks according to the schedule of milestones and deliverables as specified in this statement of work (SoW). Each reviewer's duties shall not exceed a maximum of 15 days to complete all work tasks of the peer review described herein. The tentative schedule of milestones and deliverables is provided herein.

PLACE OF PERFORMANCE AND TRAVEL

Each reviewer shall conduct an independent peer review during the panel review meeting scheduled during 22-26 April 2013 in Santa Cruz, California.

STATEMENT OF TASKS

Each reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Tasks prior to the meeting: The contractor shall independently select qualified reviewers that do not have conflicts of interest to conduct an independent scientific peer review in accordance with the tasks and ToRs within the SoW. Upon completion of the independent reviewer selection by the contractor's technical team, the contractor shall provide the reviewer information (full name, title, affiliation, country, address, email, and FAX number) to the contractor officer's representative (COR), who will forward this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The contractor shall be responsible for providing the SoW and stock assessment ToRs to each reviewer. The NMFS Project Contact will be responsible for providing the reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact will also be responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

Foreign National Security Clearance: The reviewers shall participate during a panel review meeting at a government facility, and the NMFS Project Contact will be responsible for obtaining the Foreign National Security Clearance approval for the reviewers who are non-US citizens. For this reason, the reviewers shall provide by FAX (not by email) the requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/.

Pre-review Background Documents: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the COR the necessary background information and reports (i.e., working papers) for the reviewers to conduct the peer review, and the COR will forward these to the contractor. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the COR on where to send documents. The reviewers are responsible only for the pre-review documents that are delivered to the contractor in accordance to the SoW scheduled deadlines specified herein. The reviewers shall read all documents deemed as necessary in preparation for the peer review.

Tasks during the panel review meeting: Each reviewer shall conduct the independent peer review in accordance with the SoW and stock assessment ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs shall not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and contractor.** Each reviewer shall actively participate in a

professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the stock assessment ToRs as specified herein. The NMFS Project Contact will be responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact will also be responsible for ensuring that the Chair understands the contractual role of the reviewers as specified herein. The contractor can contact the COR and NMFS Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting scheduled in Santa Cruz, California during April 22-26, 2013
3) During the panel review, conduct an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than 10 May 2013, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to Dr. David Die ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

DELIVERY

Each reviewer shall complete an independent peer review report in accordance with the SoW. Each reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each reviewer shall complete the independent peer review addressing each stock assessment ToR listed in **Annex 2**.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

March 25, 2013	Contractor sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
April 2, 2013	NMFS Project Contact provides reviewers the pre-review documents
April 22 – 26, 2013	Each reviewer participates and conducts an independent peer review during the panel review meeting in Santa Cruz, California
May 10, 2013	Reviewers submit draft independent peer review reports to the contractor's technical team for independent review

May 24, 2013	Contractor submits independent peer review reports to the COR who reviews for compliance with the contract requirements
May 31, 2013	The COR distributes the final reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COR within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: The deliverables shall be the final peer review report from each reviewer that satisfies the requirements and terms of reference of this SoW. The contract shall be successfully completed upon the acceptance of the contract deliverables by the COR based on three performance standards:

(1) each report shall be completed with the format and content in accordance with **Annex 1**,
(2) each report shall address each stock assessment ToR listed in **Annex 2**,
(3) each report shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Upon the acceptance of each independent peer review report by the COR, the reports will be distributed to the NMFS Project Contact and pertinent NMFS science director, at which time the reports will be made publicly available through the government's website.

The contractor shall send the final reports in PDF format to the COR, designated to be William Michaels, via email William.Michaels@noaa.gov

Support Personnel:

William Michaels, Program Manager, COR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-427-8155

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net Phone: 305-383-4229

Roger W. Peretti, Executive Vice President
Northern Taiga Ventures, Inc. (NTVI)
22375 Broderick Drive, Suite 215, Sterling, VA 20166

RPerretti@ntvifederal.com Phone: 571-223-7717

Key Personnel:

Stacey Miller, STAR coordinator
Northwest Fisheries Science Center
2032 SE OSU Drive, Newport OR 97365
Stacey.Miller@noaa.gov
Phone: 541-961-8475

Jim Hastie, Manager of the Population Ecology Program
Northwest Fisheries Science Center
2725 Montlake Blvd E.
Seattle, WA 98112
Jim.Hastie@noaa.gov
Phone: 206-860-3412

Annex 1: Format and Contents of Independent Peer Review Report

1. The independent peer review report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The main body of the report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Findings of whether they accept or reject the work that they reviewed, and an explanation of their decisions (strengths, weaknesses of the analyses, etc.) for each ToR, and Conclusions and Recommendations in accordance with the ToRs. For each assessment reviewed, the report should address whether each ToR of the SAW was completed successfully. For each ToR, the Independent Review Report should state why that ToR was or was not completed successfully. To make this determination, the SARC chair and reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the SARC Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not others read the SARC Summary Report. The independent report shall be an independent peer review of each ToR, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of this Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Tentative Terms of Reference

Pacific Coast Groundfish Assessment Review Panel for Data Moderate Assessments

The reviewers will participate in the Panel review meeting to conduct independent peer reviews of the data-moderate assessments of groundfish stocks managed by the Pacific Fishery Management Council. The review solely concerns technical aspects of the methods, and addresses the following ToR:

ToR 1 – Review documents detailing data-moderate methodologies according to the PFMC's ToR for the Methodology Review Process for Groundfish and Coastal Pelagic Species and draft data-moderate assessments. Evaluate if the documented and presented information is sufficiently complete. Document the meeting discussions and contribute to a summary panel report.

ToR 2 – Evaluate the technical merits and deficiencies of the proposed method(s) taking into consideration the data requirements of each method, the conditions under which the method is applicable, the assumptions of each method, and the robustness of model results to departures from model assumptions and atypical data inputs. Recommend alternative methods or modifications to the proposed methods, or both, during the panel meeting. Recommendations and requests for additional or revised analyses during the panel meeting must be clear, explicit, and in writing. Comment on the degree to which the methods describe and quantify the sources of uncertainty in the results.

ToR 3 – Evaluate technical merits and deficiencies of the application of data-moderate methodologies to each stock assessment and for their ability to monitor trends at the population level. The STAR panel can make requests of the stock assessment teams (STATs) for additional runs, but should not impose an alternative method if STATs consider this is not appropriate for the stock concerned. In the event that more than one model is presented, the review panel should recommend adoption of a preferred model, if one can be identified, for use in management.

ToR 4 – Decide through Panel discussions if the ToRs and goals of the peer review have been achieved and determine whether the science reviewed is considered to be the best scientific information available. If agreement cannot be reached, or if any ToR cannot be accomplished for any reason, then the nature of the disagreement or the reason for not meeting all the ToRs must be described in the Summary Panel Report and CIE Reviewer's report. Describe the strengths and weaknesses of the review process and Panel recommendations.

ToR 5 - Provide specific suggestions for future improvement in any relevant aspects of data collection and treatment, modeling approaches and technical issues.

Annex 3: Tentative Agenda
(Final Agenda to be provided two weeks prior to the meeting with draft assessments and background materials.)

Pacific Coast Groundfish Stock Assessment Review (STAR) Panel for Data-Moderate Assessments

April 22-26, 2013
NMFS, Southwest Fisheries Science Center
110 Shaffer Road
Santa Cruz, CA 95060

Monday, April 22, 2013

8:30 a.m. Welcome and Introductions

8:45 a.m. Review the Draft Agenda and Discussion of Meeting Format (Panel Chair)
- Review Terms of Reference for Assessment and Review Panel
- Assignment of reporting duties
- Discuss and agree to format for the final assessment document

9:00 a.m. Presentation(s) of stock assessment(s) for species 1 (STATs)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

12:30 p.m. Lunch (Lunch on your own or boxed lunches?)

1:30 p.m. Presentation(s) of stock assessment(s) for species 2 (STATs)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

5:30 p.m. Adjourn for day.

Tuesday, April 23, 2013

8:30 a.m. Presentation(s) of stock assessment(s) for species 3 (STATs)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

12:30 p.m. Lunch (Lunch on your own or boxed lunches?)

1:30 p.m. Presentation(s) of stock assessment(s) for species 4 (STATs)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

5:30 p.m. Adjourn for day.

Wednesday, April 24, 2013

8:30 a.m. Presentation(s) of stock assessment(s) for species 5 (STATs)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

12:30 p.m. Lunch (Lunch on your own or boxed lunches?)

1:30 p.m. Presentation(s) of stock assessment(s) for species 6 (STAT)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

5:30 p.m. Adjourn for day.

Thursday, April 25, 2013

8:30 a.m. Presentation(s) of stock assessment(s) for species 7 (STAT)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

12:30 p.m. Lunch (Lunch on your own or boxed lunches?)

1:30 p.m. Presentation(s) of stock assessment(s) for species 8 (STAT)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

5:30 p.m. Adjourn for day.

Friday, April 26, 2013

8:30 a.m. Presentation(s) of stock assessment(s) for species 9 (STAT)
- Overview of data and modeling approach
- Q & A session with STAT
- Panel discussion

12:30 p.m. Lunch (Lunch on your own or boxed lunches?)

1:30 p.m. Consideration of remaining Issues
- Review decision tables
- Panel agrees to process for completing final STAR report by Council's June meeting Briefing Book deadline

3:00 p.m. Draft review panel summary report

5:00 p.m. Review panel adjourns.

Appendix 3: Participants in the April 22 – 26, 2013 data-moderate groundfish stock assessment review.

Technical Reviewers
Martin Dorn, Scientific and Statistical Committee (SSC), Panel Chair
Yan Jiao, Center for Independent Experts (CIE)
Vivian Haist, Center for Independent Experts (CIE)
Andre Punt, Scientific and Statistical Committee (SSC)
Selina Heppell, Scientific and Statistical Committee (SSC)

Panel Advisors
John DeVore, Pacific Fishery Management Council (PFMC), Staff Officer
John Budrick, PFMC Groundfish Management Team (GMT)
Gerry Richter, PFMC Groundfish Advisory Subpanel (GAP)

Stock Assessment (STAT) Team
Jason Cope, Northwest Fisheries Science Center
E.J. Dick, Southwest Fisheries Science Center
Alec MacCall, Southwest Fisheries Science Center
Melissa Monk, Southwest Fisheries Science Center
Braden Soper, Southwest Fisheries Science Center
Chantel Wetzel, Northwest Fisheries Science Center